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LESSONS LEARNED USING THEORY OF MIND METHODS TO INVESTIGATE USER SOCIAL AWARENESS IN VIRTUAL ROLE-PLAY

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Abstract*: Theory of mind (ToM) methods were used to investigate children's interpretations of the social and emotional states of synthetic pedagogical characters, focusing on children's cognitive and affective empathic responses to characters in bullying scenarios and their social awareness and understanding of the characters' situations. Although cognitive approaches typically do not consider user social awareness and emotional understanding and their roles in interaction, this is critical for our research on empathic engagement. We present a novel approach focusing on story and character comprehension using concepts from ToM methods to understand children's interpretations of characters within virtual role play scenarios and compare these with an adult perspective. Our results identify that ToM methods offer considerable potential for determining user social awareness and emotional understanding, particularly highlighting that adults and children have different perspectives on how victims and bullies feel.*

Keywords: *Theory of mind, virtual role play, emotional understanding, synthetic characters, bullying.*

INTRODUCTION

Social learning is strongly related to cognitive development (Vygotsky, 1978), with emotions driving attention, learning, memory and other important mental and intellectual activities (McCombs, 1997, 2004), having a significant affect on cognitive processes (Picard, 1997). Social learning involves the development of an infinite set of intertwined abilities that continue throughout the lifespan and are moderated by experience and exposure.

A range of approaches have been taken to support social and emotional learning, with increasing recognition of the potential of intelligent computer-assisted role-play environments (ICARPEs) to provide effective, appropriate, engaging, and pedagogical experiences (Imholz, 2008). ICARPEs provide virtual learning environments (VLEs) populated by synthetic characters engaged in role-play scenarios that can offer users safe and compelling access to sensitive social and emotional experiences (Dautenhahn, Bond, Canamero, & Edmonds, 2002). A key issue in the evaluation of such VLEs is determining whether the children's responses are those that are intended by the creators of the VLE (Veletsianos, Scharber, & Doering, 2008), and whether children are demonstrating social awareness of character intentions (Berry, Butler, & de Rosis, 2005).

A wide variety of cognitive, social, and affective factors have significant impact on social learning, with empathy having been identified as critical for underpinning the emergence and consolidation of social and emotional understanding and awareness (Payton et al., 2000). Empathy can be defined as "an observer being exposed in some way to a target, after which some response on the part of the observer, cognitive, affective, and/or behavioural, occurs" (Davis, 1994, p. 12). Empathy is regulated by both cognitive and affective elements, interacting in a systemic manner to produce emotional understanding, and is essential for personal, social, and emotional learning (Payton et al., 2000). The affective capacity a person has indicates the level to which they are able to share in another's feelings, whilst cognitive ability specifies the degree to which a person can understand another individual's feelings and perspective.

When the focus of interaction is on exploring social rather than cognitive activities, then inevitably we must move away from cognitive approaches and grounding (Rogers, 2004). Cognitive theories and approaches have resulted in interfaces that reflect cognitive limitations and requirements and that contribute to effective task achievement through underpinning cognitive activity. Several cognitive approaches have been extended to consider the interplay between user, domain, environment, and work tasks (Dourish, 2001; Nardi, 1996; Theureau, 2003). However, such approaches consider tasks that are purposeful and focus on skillful completion rather than on social and emotional elements. A further issue with the relevance of cognitive approaches to social learning is that most ignore the developmental aspect of cognition, a key factor for social learning.

Empathy, and particularly empathic cognitive abilities, requires the ability to represent the mental states (thoughts, feelings, desires, hopes) of others, skills that have been referred to as theory of mind (Leslie, 1987). Theory of mind (ToM), or metacognition, refers to the ability to understand the thoughts, beliefs, and intentions of others, an important ability in order to explain and predict behavior in the social world around us (Premack & Woodruff, 1978). From a natural and inclusive perspective, ToM is "simply having an ability to engage in our everyday folk psychological practices of attribution, interpretation and prediction" (Davies & Stone, 2003, p. 82). Yet ToM abilities reveal an understanding of an interconnected network of mental states, with emotional understanding critical for social functioning (Astington, 2003). Although much ToM research has focused on young children and autistic spectrum disorder children and adults, work with older children highlights that older children understand and focus on other people's motives and emotions rather than judging beliefs and mistakes (Cutting & Dunn, 1999; Dunn, 1995). Children have a sophisticated and complex understanding of emotions and of their social interpretation, with

ToM studies revealing that children of any age can readily take another's perspective in the case of desires and emotions, even where that perspective results in actions or desires different from the child's (Denham, 1986; Wellman & Woolley, 1990).

Computer-based learning where children's metacognitive development has been considered has typically focused on complex cognitive tasks rather than social factors. For example, Clements and Nastasi (1999) focus on the potential of computer environments to enhance metacognitive skills related to problem solving and learning. The importance of social factors for metacognition was recognized particularly in terms of collaborative working and the necessary social coordination to achieve this cognitive end. However, the focus of our research is not on the children's social awareness but rather on the contribution of social activity to the purposeful task engaging the child.

ToM is a concept closely interlinked with empathy and can be used to determine children's perceptions and interpretations of others, permitting a consideration of both the affective and cognitive elements of empathy. ToM abilities are pertinent to competent social interactions, as they enable us to view and make sense of other people's thoughts, beliefs, and behavior. ToM abilities have an impact on social competence (Lalonde & Chandler, 1995), with studies highlighting that children with good mind-reading skills tend to have more successful social relationships and interactions. In studies focused at typically developing children and adults, belief understanding and emotion understanding are closely related (Dunn & Hughes, 1998; Hughes & Dunn, 1998). Whilst there are cognitive approaches that also focus on social and affective aspects, most seek to account for decisions and actions. However, where empathy is being considered, the task and information structures to support it become woefully inadequate as a means of understanding human interactions.

In this paper, we discuss a novel approach for story and character comprehension using concepts from ToM methods that focuses on children's cognitive empathy, their social awareness, and their understanding of a variety of synthetic characters and various situations within virtual scenarios. ToM methods offer considerable potential for determining whether a child has appropriately interpreted and understood the emotional and social content from a range of virtual role play situations with synthetic characters. Firstly, we consider the use of virtual role play as an approach to provide social and emotional learning, followed by a discussion of ToM methods. We then discuss our study methods and procedures for understanding and evaluating children's social and emotional interpretations with FearNot! software. The Results and Interpretation Section addresses the merits and problems of this approach, which is then followed by our conclusions.

USING ROLE PLAY IN SOCIAL AND EMOTIONAL LEARNING

Cognitive, affective, and behavioral learning is achieved through experience (Kolb, 1984; Kolb, Boyatzis, & Mainemelis, 2001), with knowledge emerging "from the combination of grasping and transforming experience" (Kolb, 1984, p. 41). One of the fundamental processes for empathy to develop is role taking, "the attempts by one individual to understand another by imagining the other's perspective" (Davis, 1994, p. 4), which is supported through role-play, an experiential technique in which attitudes, feelings, and social interaction can be explored, providing an understanding of another's perspective (Pohjola, 2004).

In role-play, social interaction is used as the stimulus for challenging and changing existing beliefs (Piaget, 1972) and can result in significant behavioral changes (Lewin, 1951), making it highly relevant for social and emotional learning (Davison & Arthur, 2003; Henriksen, 2004). The high level of drama in role-play approaches, such as Theatre in Education (Jackson, 1993) and Forum Theatre (Boal, 1979), result in an immediacy that is more likely to evoke emotion than other learning approaches (van Ments, 1983). The basic premise of role-play is that it is easier to empathize with how another person might feel under certain circumstances if one has experienced something similar, even symbolically as part of role-play (Robertson & Oberlander, 2002). However, it can be difficult to support role-play in the classroom (Brookfield, 1990), even with the use of advanced technology.

Although educational role-play using synthetic characters has been explored for social and emotional issues, it has mainly focused on language learning (Prendinger & Ishizuka, 2001) and educational drama and story telling, such as Ghostwriter (Robertson & Oberlander, 2002), Teatrix (Machado & Paiva, 2001), Virtual Puppet Theatre (Andre, Klesen, Gebhard, Allen, & Rist, 2000), and Oz (Bates, 1994). Recently, results have highlighted the potential of synthetic characters for empathic engagement (Gratch & Marsella, 2001; Marsella & Johnson, 2003), providing children with a safe environment for experiential social and emotional learning (Aylett, Paiva, Woods, Hall, & Zoll, 2005; Paiva et al., 2004), and allowing the user to experience the character's emotions and problems in a distanced way, while being at the same time engaged in what happens to the characters.

The research reported here is occurring within the European project eCIRCUS (**E**ducation through **C**haracters with Emotional-**I**ntelligence and **R**ole-playing **C**apabilities that **U**nderstand **S**ocial Interaction). In eCIRCUS we are aiming to support social and emotional learning within personal and social education through virtual role-play with synthetic characters in a 3D environment that establishes credible and empathic relations with the learners. In this paper, we focus on a showcase software program developed in eCIRCUS: FearNot! (**F**un with **E**mpathic **A**gents to **R**each **N**ovel **O**utcomes in **T**eaching). This application focuses on exploring bullying and coping strategies for 8- to 12-year-olds. Children interact individually with FearNot! by watching the synthetic characters interact in bullying scenarios and providing feedback or advice to the victim character via interactive options, thus taking the role of an "invisible friend."

In attempting to understand the impact of virtual role-play on social and emotional learning, our evaluation has focused on a variety of research questions linked to the domain of bullying and, in more general terms, focusing on emotional responses, understanding storylines, empathic responses to the synthetic characters, and so forth. Whilst much of earlier work has focused on the implementation of a cognitive and affective architecture and user experience, here we consider the impacts of virtual role play on cognitive empathy. This paper discusses the use of ToM methods, emphasizing that a social approach is more appropriate for gaining insight into cognitive empathy than focusing simply on cognition. We have used this approach for the interpretation of interactions with FearNot!, focusing on interpreting children's responses in an environment for exploring strategies for coping with bullying.

USING THEORY OF MIND

ToM is the ability to predict and explain other people's behavior through referring to mental states, with this ability to correctly attribute beliefs, desires, goals, and percepts to others being a key factor in human interaction and social dynamics. Without such metarepresentational abilities, we would be unable to understand the behaviors of others in many social situations. ToM provides a crucial step in human development, typically emerging in early childhood (Fodor, 1992), as we develop an awareness that others may have different knowledge, beliefs, and goals than our own.

ToM is a vital aspect for social interaction, and where ToM does not develop, as in the case of many autistic individuals, this presents serious challenges (Baron-Cohen, Leslie, & Frith, 1985). Studies have identified that, for many autistic individuals, the understanding and interpretation of others' social and emotional behaviors is very limited and may continue to be so throughout the lifespan (Jarrord, Butler, Cottingtin, & Jimenez, 2000), leading to significant social and communicative challenges.

There is abundant evidence from experiments using false belief tasks (Wellman, 2002) that preschoolers begin to develop a ToM and, by age 6, they should have a sound understanding of first-order ToM abilities (Wellman, Cross, & Watson, 2001). First-order ToM is typically examined using a false belief task. For example, a child is shown the contents of a Band-Aid box and an unmarked plain box. The Band-Aids are in the unmarked box and the Band-Aid box is empty. The adult introduces the child to a puppet and asks the child to predict where the puppet will look for the Band-Aids.

During middle childhood, ToM abilities become more elaborate and complex, and children typically acquire the ability to solve second-order ToM tasks. Second-order ToM abilities require the child to understand that his/her beliefs about other people's beliefs can be wrong, and studies of these abilities invariably involve complex stories given to the child (Astington, Pelletier, & Homer, 2002).

Although first-order ToM abilities are said to be a good predictor of social skills (Jenkins & Astington, 2000), equivocal evidence has been reported from other studies. Dunn (1995) found that competent false belief understanding at age 3 was related to reports of behavioral and peer difficulties at age 6. Specifically, children reported problems in making and keeping friends, and avoiding social activities with peers. In contrast to popular belief, it was the children who were slower to acquire ToM abilities that reported greater peer popularity. Yet others have reported that children who have ToM deficits have problems with peer rejection and show heightened aggression (Hughes, Dunn, & White, 1998; Peterson & Siegal, 1995).

Some studies (e.g., Happe & Frith, 1996) have not found any differences in first-order ToM abilities between normally developing children and conduct-disordered children, who typically have problems with aggression and are rejected by peers. Other research focusing on the perpetrators of bullying behavior reported that bullies frequently show sophisticated ToM abilities and labeled them as possessing "a theory of nasty minds" (Sutton, Smith, & Swettenham, 1999, p. 124).

Social and emotional understanding as a key aspect of ToM was highlighted through Dunn's (1995) paradox, where children who clearly had appropriate ToM as expressed through their emotional and social interpretation were unsuccessful on typical ToM tasks. Children are particularly able at understanding other's emotional perspectives and the impact

on related actions, even when that response would be different from their own. Studies focusing on the social and emotional interpretative aspects of ToM have identified that older children's ToM is based on their interpretation of other's motives and emotions (Astington, 2003), with this emotional interpretation having a greater impact on ToM than an attribution based on other's beliefs.

In virtual role-play, understanding children's interpretations of social interactions with and between characters remains problematic. However, methods based on ToM offer considerable potential to evaluate whether these interactions do result in the desired personal, social, and emotional learning outcomes that will result in the improved cognition required by educators and stakeholders. The ToM methods (e.g., the Sally-Anne task; Baron-Cohen et al., 1985; Premack & Woodruff, 1978) that are used to assess and investigate mental state attribution and its impact on social interpretation also offer potential for investigating the same phenomena in children interpreting synthetic characters in virtual role play situations.

ToM offers considerable advantages when compared to cognitive approaches. Even approaches such as activity theory (Nardi, 1996) and distributed cognition (Hutchins, 1995), which also consider social and contextual aspects, have significant limitations for understanding user social awareness and empathy. Whilst activity theory provides an interconnected set of concepts that can be used to frame and explore interactions and provides a historical and cultural analytical framework, the hierarchical model of activity that this theory applies has little relevance in the social context. Both distributed cognition and activity theory are intended for the workplace and apply less readily to a less structured task space, nor do the analytical frameworks provided readily support the investigation of the personal, social, and emotional activities engaged in social learning.

Cognitive approaches have been applied to learning, but not to social learning. Scaife and Rogers' (1996) framework of cognitive interactivity focuses on a design that ensures effective task completion for cognitively effortful learning tasks. However, we are attempting to understand children's interpretations of social interactions with and between characters, a task neither cognitively effortful nor possible from which to identify what constitutes "effective task completion." Indeed, even the user does not consider the activity to be a purposeful task, but rather a social interaction. ToM methods offer considerable advantages, allowing the user to engage in non-goal-oriented interactions rather than in a purposeful task with a clear structure, as required by most cognitive approaches.

The ToM assessment in eCIRCUS evaluates children's perceptions of the synthetic characters and their behaviors. A variety of approaches have been used to explore children's metacognition, including dynamic interviews, think aloud, and video analysis (Clements & Nastasi, 1999). However, ToM provides a more subtle approach that allows us to investigate whether children could appropriately recognize and interpret the synthetic characters' behaviors, appearance, and affect, without explicitly focusing on this information. The approach allows one to determine what children understood and interpreted from the characters, and what goals and intentions they ascribed to characters. It also provides some insight into cognitive empathy, that is, whether children can understand another individual's feelings and perspective.

METHOD

Participants

The program Virtually Friends took place at the University of Hertfordshire in the summer of 2004 and involved 345 children: 172 male (49.9%) and 173 female (50.1%). The sample age range was 8 to 12, with a mean age of 9.95 ($SD = 0.50$). The sample comprised children from 10 primary schools in Hertfordshire, UK. Each class participated in the all-day event (2 classes per day), including interactions with robots, FearNot! and storyboarding software.

Procedure

A large screen overhead projector was used to give a presentation introducing the participants to the day's activities and to the evaluators. Prior to engaging with the FearNot! scenarios, children completed several questionnaires assessing empathy, bullying behavior, and emotion recognition.

The participants were placed at a standard Windows-enabled PC, one per participant, each running FearNot! Each child then individually interacted with FearNot! for approximately 30 minutes. Our work has identified considerable gender variations in responding to the characters and scenarios (Hall, Woods, Wolke, & Dautenhahn 2007) and the scenarios provided were gender specific, with boys interacting with a physical bullying scenario (see Figure 1) and the girls with a relational scenario (see Figure 2). Relational bullying is typified by social exclusion, verbal and emotional harassment, and isolation (Crick & Grotpeter, 1995), while physical bullying is typified by aggressive behavior. Each scenario incorporated 4 episodes and began with an introduction to the characters, school, and situation.

The process of interaction with the FearNot! software is significantly similar for the physical and relational bullying scenarios. In the physical scenario, after the introduction, the user views a bullying incident involving physical and verbal aggression, with Luke (the bully) bullying John (the victim). John then seeks safety in the school library, where, through the software program, he then engages the child user, seeking advice for his bullying situation. Within the initiated advice dialogue, the user selects an item of advice from a list of coping
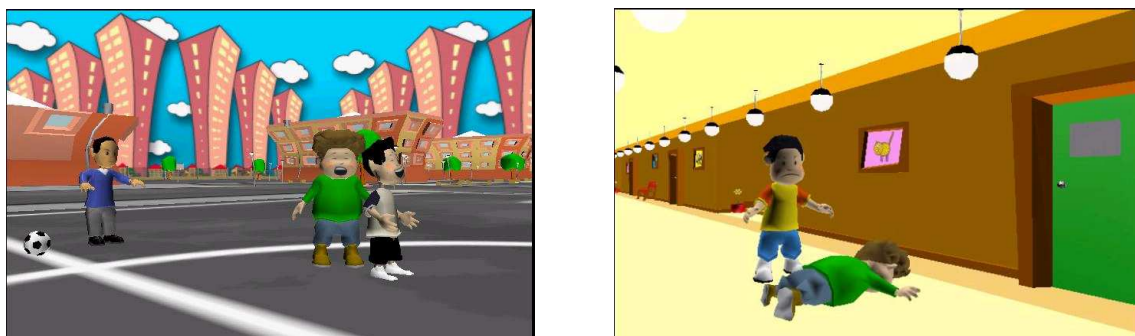

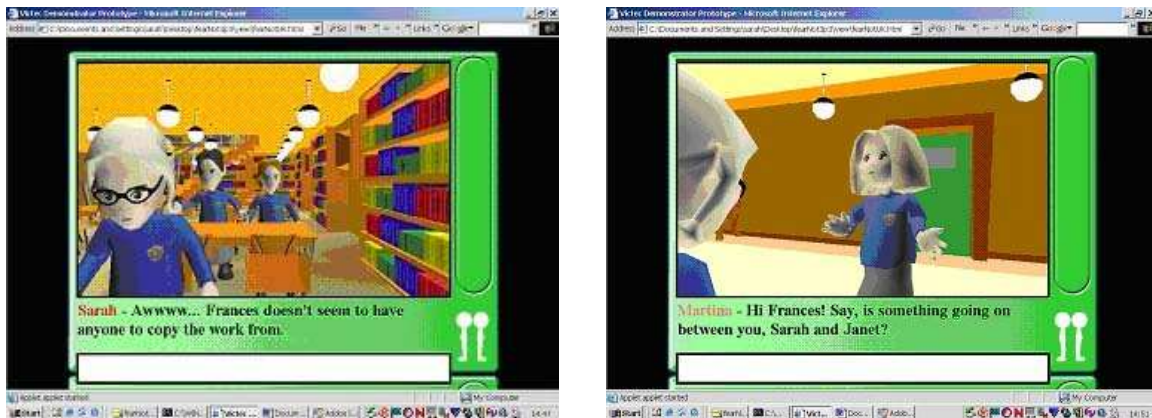**Figure 1.** Scenes from the physical bullying scenario in FearNot!

Figure 2. Scenes from the relational bullying scenario in FearNot!

strategies from a drop-down menu. In the free-text portion, the user explains his/her selection and what he/she thinks will happen after having implemented the selected strategy. The user's recommendations to the victim character may have an impact on the victim character's interaction, with the victim possibly selecting the coping strategy suggested by the user, although this is not certain. Whether the user's responses impact the success of the character's approach to coping with bullying depends on the strategy suggested. If the child suggests an appropriate coping strategy—for example, telling someone, a bystander or adult in the scenario setting—the scenario will reflect the proactive help to the victim in combating the bullying. If the user selects a strategy deemed likely to be unsuccessful by the victim, such as to run away or fight back, the victim character will then reject the help in the final episode. To ensure an appropriate educational message provided by the software, no matter which strategy is selected, and in line with the requirements of teachers and school bullying policies, FearNot! ends with a positive message identifying that an appropriate strategy for coping with bullying is to tell someone you trust.

The relational scenario provides the introduction, bullying incident, advice dialogue, further episodes and dialogues, and positive final message. Since relational bullying typically involves a bully who is supported in the verbal bullying by others (Salmivalli, Lagerspetz, Björkqvist, Österman, & Kaukiainen, 1996), this scenario involves a bully assistant (Sarah) who engages in the bullying activity with the bully (Janet) against Frances (the victim). As in the physical scenario, after this incident Frances goes to the library and engages in a dialogue with the user.

After the interaction with FearNot!, children completed the ToM assessment. Finally, participants completed a questionnaire on their interaction with FearNot! and participated in a brief discussion about their experience.

Measures

The ToM questions were devised by experts in the field and were based on the first-order and second-order false belief questions used by Happe and Frith (1996). They were extensively piloted in terms of child comprehension and validity with other measures. Piloting took place in Hertfordshire, UK and involved classes representative of the sample used in Virtually Friends, predominantly composed of UK natives. They included questions about inferring the emotions,

mental states, and intentions of the main characters in the story, and were presented in an electronic format to the child immediately after they had interacted with FearNot! The ToM assessment included screen shots from FearNot!, providing the child with memory anchors from action scenes within the scenarios, such as Luke (the bully) physically bullying John (the victim).

The ToM assessment comprised two response formats: categorical responses, where the child was instructed to select the correct response box, and text responses, where the child was instructed to write brief sentences. In the first format, the child was instructed to click the button they thought represented the emotions of the character. These were provided as drawn faces with emotional expressions, based on a subset of Ekman's (Ekman & Friesen, 1986) six identified emotions: happiness, sadness, anger, and fear. Surprise and disgust were removed as options after a pilot study indicated that children had difficulty in clearly identifying these (Woods, Wolke, Nowicki, & Hall, in press). In addition, a "Neutral" face was provided.

The emotion questions, with the exception of the first question, permitted the generation of frequency and percentage data. The ToM assessment also included open-ended questions about the children's various cognitive and affective perspectives, drawn here as an example from the physical bullying questions:

- *Comprehension*. The first question related to story comprehension: Does the child recognize this as a bullying event?
  - What do you think is happening in this scene?

- *Initial emotion questions*. These relate to character emotions at the beginning of the interaction with FearNot! and directly after the main bullying incident(s).
  - How does Luke (bully) feel at the beginning of the story?
  - How does John (victim) feel at the beginning of the story?
  - How does Luke (bully) feel after he has hit and pushed John over?
  - How does John (victim) feel after Luke has hit and pushed him over?

- *Bullying event questions*. These questions follow the initial emotion questions and refer to the main bullying incident(s).
  - What does Luke (bully) think about John (victim)?
  - What does John (victim) think about Luke (bully)?
  - If you were John (victim), why do you think that Luke (bully) is doing this?
  - If you were Luke (bully), why is he doing this to John (victim)?

- *End emotion questions*. These questions follow the bullying event questions and ask the child about the characters' feelings at the end of the scenario (once coping styles have been tried, etc.).
  - How does John (victim) feel at the end of the story?
  - How does Luke (bully) feel at the end of the story?
  - How do you [the child] feel at the end of the scenario?

Assessing Theory of Mind Skills

The analysis approach involved considering the data generated by the children to identify frequency and percentage data from the categorical ToM questions. However, whilst this frequency and percentage data enabled us to identify the most and least typical emotional responses, it did not indicate whether the children's understanding was appropriate nor whether their responses revealed effective ToM skills. Because ToM skills develop throughout life, we took the view that adults would be more likely to select the appropriate emotional response. To determine the level of appropriateness of the possible responses, we developed a scale of correctness for both the relational and physical bullying scenarios.

The scale of correctness for each of the scenarios was created through pooling the data from six researchers. All six were familiar with the eCIRCUS project and our aims with FearNot! Each adult followed the same research procedure as the children, that is, interacting with both of the FearNot! scenarios and completing the ToM assessment for each, interpreting what the various characters were feeling at specific points in the scenario.

The adults were then asked to rate the appropriateness of the five emotions for each of the ToM assessment questions on a simple 5-point scale ranging from 1 (*most correct*) to 5 (*least correct*). This correctness relates to the pooled adults' views of how the character would be feeling. The pooled results were used to create scales for each of the scenarios based on what adults considered a correct emotional response through to an incorrect interpretation. Although multiple correct perspectives (for example that the victim might be sad and angry) are possible, high consensus was found among the adults, with one of the emotions being typically seen as the most appropriate. The following section focuses on a comparison of children's responses with the adults' pooled responses as represented through the scale of correctness.

RESULTS AND INTERPRETATION

Here, we present key findings regarding a comparison of child and adult perspectives on character ToM. Additional results can be found on the bullying scenario (Hall, Woods, Aylett, & Paiva, 2006) and on the relational scenario in Hall, Woods, Hall, and Wolke (2007).

Emotional Interpretations at Scenario Start

All six of the adults believed that the physical bully would be happy at the beginning of the scenario. While there was less consensus for the relational bullies, happiness was the dominant state, although some adults identified that the relational bullies may be angry and, for one adult, that the bully assistant was neutral. Nearly 50% of children stated that the bully in both the physical and relational bullying scenario felt happy at the beginning of the story, followed by feeling angry or neutral. Thus, whilst adults overwhelmingly took the view that the physical bully would be happy, children were less convinced, with 24.3% believing he would be angry. A few children even stated that the bully felt sad at the beginning of the stories. A similar pattern was found for children's emotion interpretations for the relational bully assistant, with 44% stating that she felt happy, followed by 27% stating that she felt

angry at the start of the story. As Figure 3 shows, the children generally are displaying an appropriate perspective (as defined from an adult perspective) of the bullies' emotional states; however, they are more likely than adults to view the bully characters as angry.
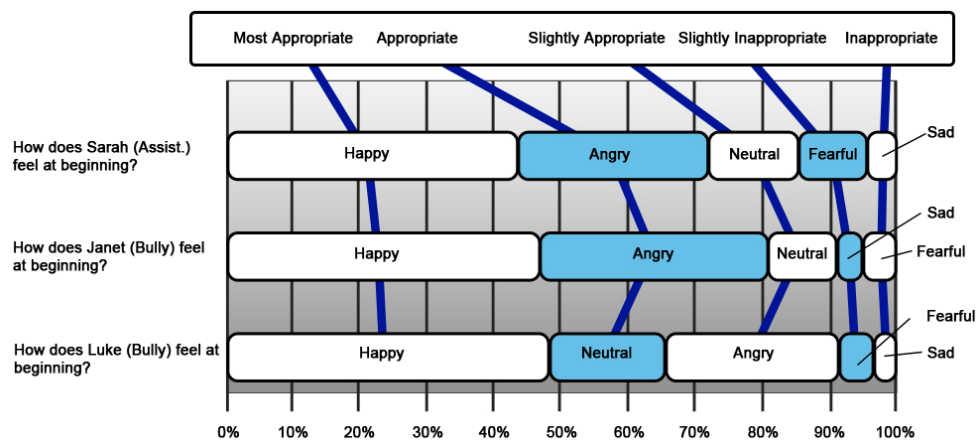

Figure 3. Children's interpretation of bullies' emotions at scenario start.

Adults stated that the victims would feel sad or fearful, see Figure 4. Sadness was the dominant emotional state identified by the children, with approximately 70% of children interpreted the victim in both the physical and relational scenario as feeling sad at the beginning of the story, followed by around 20% stating that the victim felt fearful.
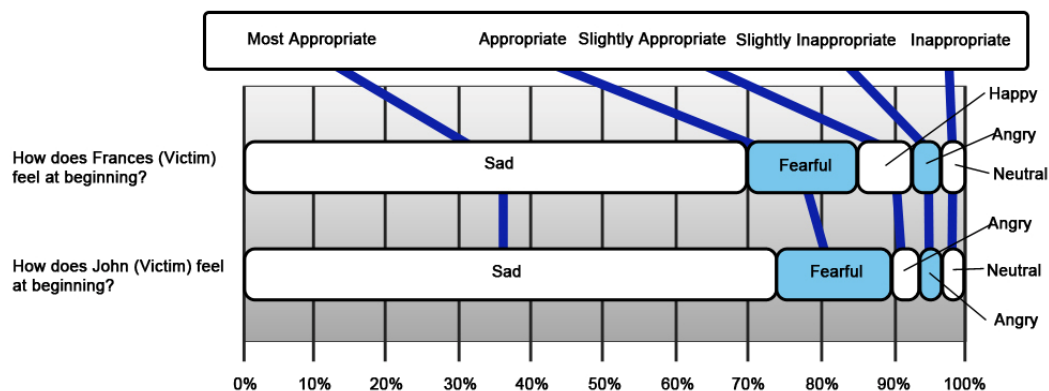

Figure 4. Children's interpretation of victims' emotions at scenario start.

Emotional Interpretations after Bullying Incident

Adults interpreted the emotional state of both the relational and direct bullies after the bullying incident as typically being happy, with anger also being appropriate. For the bully assistant (in the relational scenario), adults identified that the most likely state was happy with the second most likely state being neutrality. For the children, happiness was felt to be the dominant emotional state of the bullies, with just under 80% of children responding that the bully character in both scenarios felt happy after the successful bullying, see Figure 5. Whilst
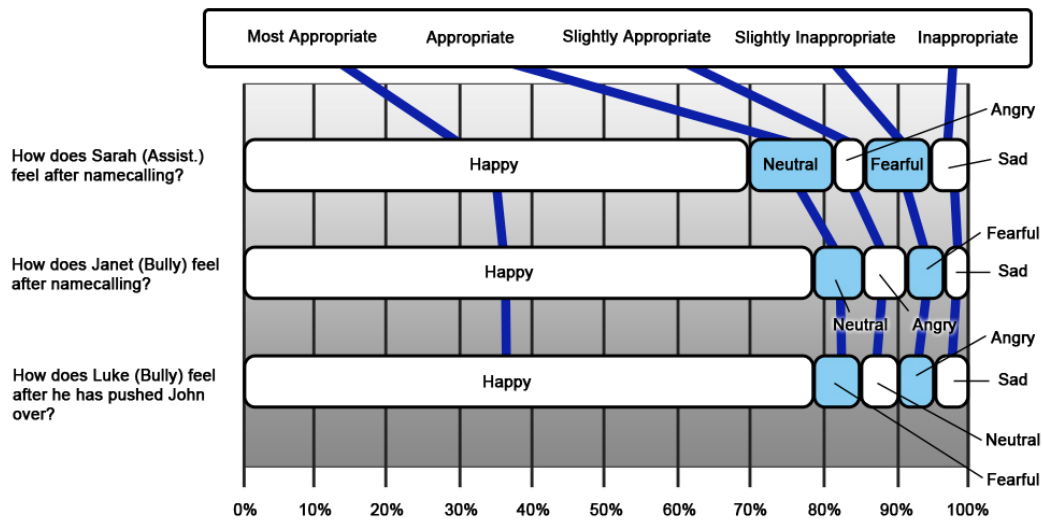
Figure 5. Children's interpretation of bullies' emotions after incident.

the bully assistant was typically seen as being happy, some children indicated that she could be sad or fearful.

The outcome of the relational bullying was very clear for both the adults and the children (see Figure 6), with 85% of children interpreted that the victim felt sad after being called nasty names. Although adults agreed that the physical bullying victim would typically be sad after the incident, the children were less convinced, with 61.5% feeling that the victim would feel sad and just under a third of children indicating the victim would be angry or fearful. No adult thought that the victim in the physical scenario would be angry.
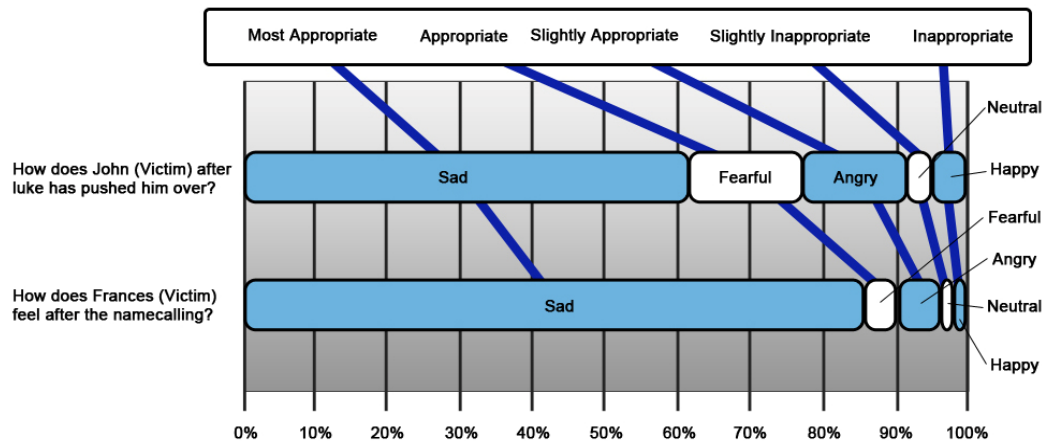

Figure 6. Children's interpretation of victims' emotions after incident.

Emotional Interpretations at Scenario End

These results relate to how the characters could have felt at the very end of the scenario. At the end of the physical scenario, all of the adults perceived that the physical bully was feeling happy. In the relational scenario, adults mainly felt that the relational bully was feeling

happy, although anger and neutral were also identified as possible emotional states. However, the children's perspective of the emotional state of the bullies was quite different in the range of emotions being identified (see Figure 7). In the physical and relational scenarios, 35% and 38% of the children, respectively, stated that the bully felt angry at the end of the story, followed by 25% & 29%, respectively, who said that the bullies felt happy. This was followed by around 20% of children believing that the bullies felt sad at the end of the story.
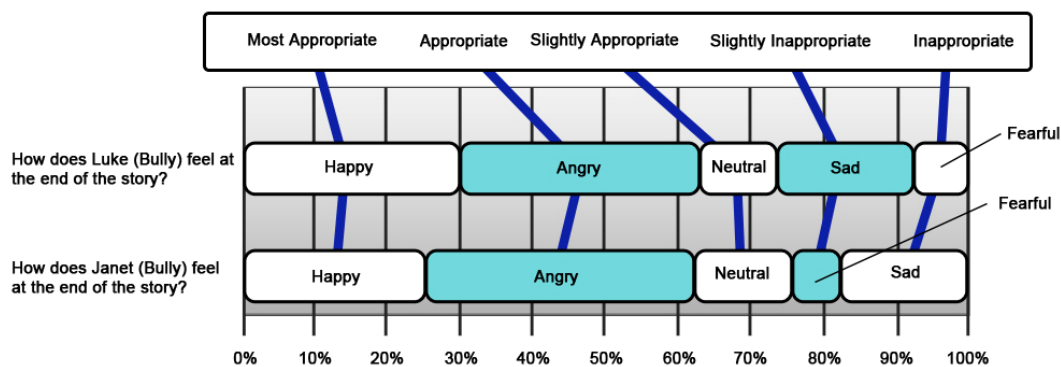
Figure 7. Children's interpretation of bullies' emotions at stories' end.

With regards to how the victim characters felt at the end of the story (Figure 8), around 60% of children responded that the victim in both scenarios felt happy, and over 20% believed that the victim felt sad. This is in marked contrast to the adults, who had a completely different ToM of the victim character at the end of the scenario, with happiness identified as an inappropriate emotion.
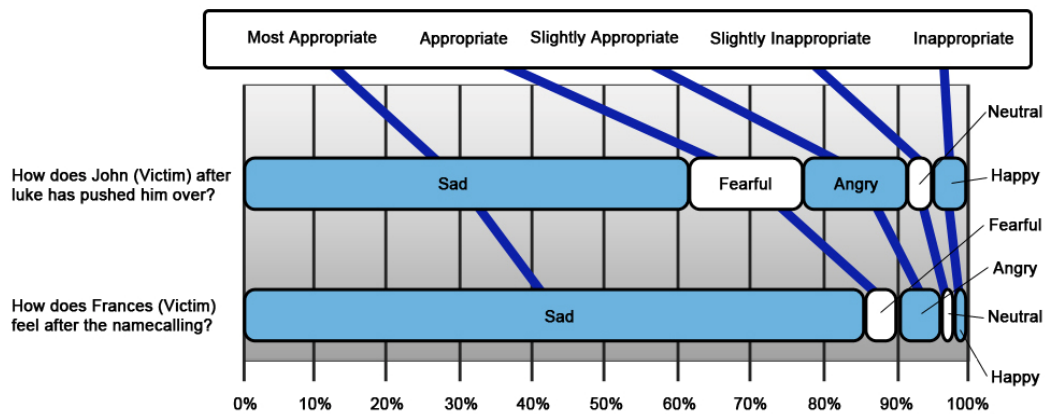
Figure 8. Children's interpretation of victims' emotions at stories' end.

Scenario Profile: Character's Changing Emotional State

Children viewed the bullies in both scenarios as being happier at the beginning of the scenario as compared to the end, with most happiness experienced immediately after the bullying incident (see Figure 9). The relational bully assistant had similar ratings as the relational bully, but that information is not included in the following diagrams for clarity. The

physical and relational bullies are seen by many children as frequently being angry, not only during a bullying incident but also at the beginning and end of the scenario. There is considerable similarity in children's interpretations of ToM in both scenarios.
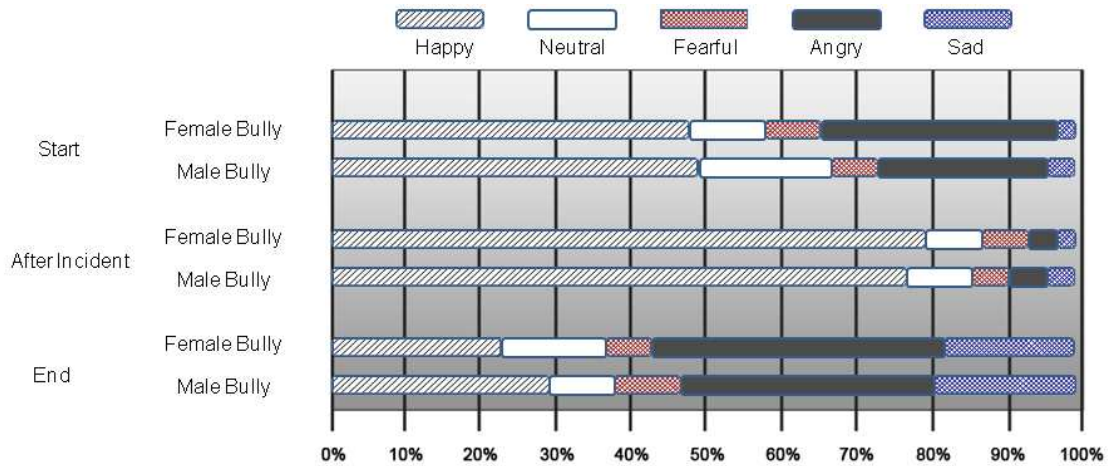

Figure 9. How children thought the bully felt at the beginning, during, and end of each scenario.

Children's views of the victims' emotional states at the end of the scenario were unexpected (see Figure 10). Both victims are seen as sad at the beginning and after the bullying incident, but by the end of the scenario they are viewed as happy.
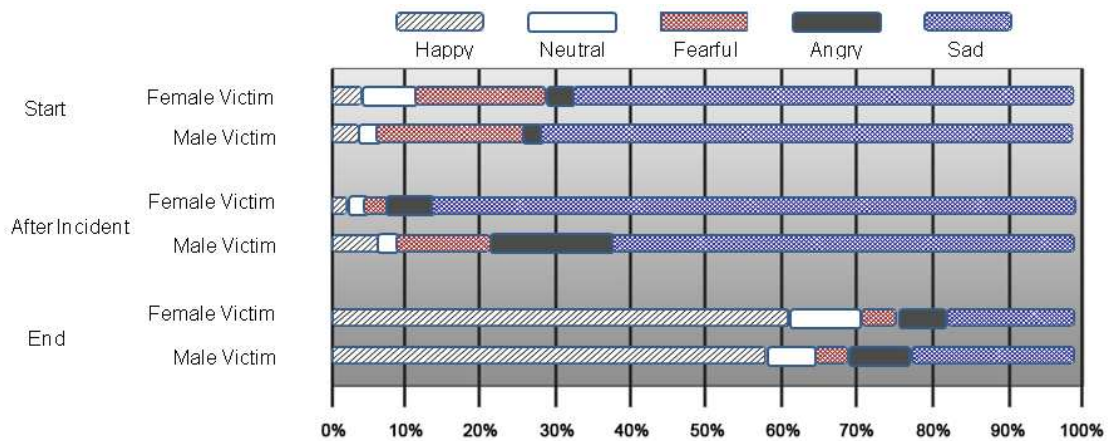

Figure 10. How children thought the victims felt at the beginning, during, and at the end of the scenario.

DISCUSSION

Our focus in this paper has been on the use of ToM methods as an approach in HCI research to gain insights into children's social and emotional interpretation of synthetic characters. Such methods offer an alternative to cognitive approaches, providing a focus on the social aspects of understanding metacognition regarding children's abilities to correctly attribute beliefs, desires,

goals, and percepts to others. In this study, the focus was on the children's perceptions of bullying in a virtual scenario, where the participants were synthetic characters rather than actual children participating in a real experience. The purpose with this research was to investigate whether children could exhibit emotional response to the synthetic characters within this VLE, not whether these emotions reflect the real emotional experiences of either bullies or victims. The results detailed here focus on the categorical data collected, relating primarily to first-order ToM in children when compared with adult views of character ToM. The scale of correctness, based on knowledgeable adults' interpretations, was intended as a measure to identify whether the scenarios were generating the appropriate or expected emotional and social interpretation from children. There was some consensus between adults' and children's interpretations and tendencies within both sets of data. We have also identified that adults' views of the characters' emotions diverge, particularly in relation to how the characters are feeling at scenario end.

The emotional perspectives of the characters at the beginning of the scenario are supported through a voice-over of the back story for each of the characters as they are making their way to school. In these character introductions, the victims are clearly presented as being isolated individuals in a challenging social situation where they are experiencing bullying. As expected, at the beginning of the scenario, children viewed the victims as being sad or fearful, showing social understanding and awareness that being bullied will have a negative emotional impact on the victim.

Although the relational bully was viewed as happy, many children indicated that the physical bully was angry. This view relates in part to the introduction to the characters, where Luke is presented as an angry child, known for "pushing others around" and "in trouble for fighting." The introduction to Luke provided in the first episode of the physical bullying, shows him with a gang of friends and his face projects more angry and neutral facial expressions than happy. Whilst the relational bully and bully assistant are also identified as being unpleasant, with behaviors such as "name-calling" and "being unkind and unfriendly," their introduction is less negative, with them having mainly happy and neutral facial expressions.

Whilst adults and children had similar views about how the victim is feeling after being bullied in the relational scenario, there were differences in the interpretation of the physical victim's emotional state. The adult perspective was that victims would feel sad and fearful after being bullied; however, many of the children thought that the victims would feel angry. This result is possibly at least partially the result of difference of social and cultural values between children and adults, with anger rarely viewed as acceptable in an adult context and thus a less appropriate response. Ensuring ToM and the affective elements of human interaction are designed appropriately for the age group requires that values incorporated into the characters and scenarios are credible, believable, and appropriate. This highlights a major challenge faced in designing software such as FearNot!, with participatory design seen as key to achieving ICARPEs that result in a positive user experience that fulfills pedagogical aims. Current work focuses on extending our participatory design methods to further investigate the design of personal, social, and emotional factors in characters intended for children and teenagers, with the aim of bestowing virtual agents with behaviors that better facilitate empathy in the users.

In both scenarios of FearNot!, children interacted with the victim, aiming to support him/her in improving life through coping with the bullying. The open-ended questions identified that advice given by users is based both on their interpretation of the victim's social and emotional state and on their view of what a successful strategy might be in light of the

bullying context. The ToM assessment identified that, in the case of the relational bully, children recognized that she is not happy at the end, implying that, even for the perpetrator, bullying is not a positive interaction style, a perspective that we had hoped to achieve with FearNot! In this study, children interacted with FearNot! for only a single session, followed by a short discussion of the bullying experience to reinforce learning. To assess the learning impact of FearNot!, we have conducted a large scale, classroom-based longitudinal evaluation of FearNot! This has recently identified that interacting with FearNot! does have a positive impact on coping with bullying behavior (Sapouna et al., in press).

In the physical scenario, children appeared to view the bully as a flawed, angry individual; this perception impacted their views of the successfulness of coping strategies. For example, hitting back was advocated by many children as a way of dealing with the physical bully Luke, reflecting the view that responding in kind is a valid response to aggression. Anger was also identified as a likely emotional state for the victim to feel after the bullying incident. This clearly is not the response desired by educators and parents. Thus, the bully's introductory scenes in FearNot! Version 2.0 have been slightly modified, aiming to provide a happier, less aggressive character with friends with whom he enjoys sports, rather than the bullying gang cast in the version of FearNot! discussed here.

The children's different perspectives of the relational bully and her assistant reflect findings (Salmivalli et al., 1996) that assistants often have poor social and emotional abilities that result in angry, confused individuals frequently involved both in bullying and being bullied. Thus the children's interpretation of the bully assistant, who displayed very similar emotional expressions as the bully throughout the scenario, reflects their awareness and understanding of bully assistants.

However, the most surprising results were achieved at the end of the scenario, where the adult and child views of the characters' emotional states can be seen to have little consensus. Regarding the bullies, the adults believed that these characters would be happy, while the children typically did not see this as the final emotion, but rather anger and sadness being identified as likely emotions. This divergence applies also to the victims' final emotional states at the end of the scenarios: Whilst adults considered happiness to be inappropriate, this was the dominant emotion identified by children.

Adults had a similar view of the victims' states at the beginning and end of both scenarios, interpreting that the victim characters were sad. However, the children felt that the victims were far happier at the end of the scenario than at the start. The most likely reason for this perspective is that the child user believes that, through an intervention provided by the FearNot! program, he/she has helped and supported the victim and improved his/her life, and thus the characters' happiness is derived from having interacted with the user. Whilst this may sound unlikely, almost all children believed that they had helped the character, even if the character ignored their advice (Hall, Woods, Aylett, & Paiva, 2006).

The scale of correctness was based on the view that the adult perspective would provide the most appropriate ToM. As ToM develops throughout life, becoming increasingly refined, we assumed that the more sophisticated adults would have a greater (and implicitly better) social understanding of the situation and of how the characters were feeling. However, the use of this instrument has identified that children's perspectives are considerably different from those of adults, particularly in relation to how a child victim is perceived to feel at the end of a bullying scenario. These results illustrate differences in engagement with the scenarios and in

terms of the adult and child perspectives of bullying. This difference in bullying perspective has been identified in other studies, recognizing that children's view of bullying and its impacts can differ significantly from those of adults (Rigby, 2002). With FearNot!, the adult perspective is mediated both by the social distance between adults and children and by social expectations (e.g., not to display anger), whilst the child's perceptions display greater social proximity to the characters and engagement in the scenarios. In attempting to understand this difference, it seems likely that the adults gauged the emotional state of the characters in a detached manner, not really empathizing with the characters nor really experiencing the suspension of disbelief achieved by children. The results highlight that a ToM can be derived through interaction with synthetic characters in affective scenarios. However, this ToM and the children's emotional response to the characters was not necessarily that anticipated by adults. In related studies we have further investigated this issue, identifying that children exhibit greater empathy with the FearNot! characters than do adults, and that adult researchers were being more empathic than teachers or the public (Paiva et al., 2004).

The adult response shows a lack of engagement with the characters, with children responding with a higher level of empathic engagement. Effectively, the children seemed to be viewing the social complexity of the situation and thinking more about the victim characters than the adults did, imagining what it might be like after (yet another) unpleasant encounter with the bully. For example, although the relational bully is seen as being happy throughout most of the scenario, at the end many children saw her as angry or sad, suggesting that the bullying is having a negative rather than a positive impact on her emotional state. For the victim, the child user knows that he/she had experienced a supportive, appropriate interaction (with the child) and it seems likely that this may be the underpinning reason for the victim characters' happiness.

Through the interaction with FearNot!, we are aiming at providing children with exposure to coping with bullying with the intention of providing those children with the impetus and understanding that will permit them to reduce and prevent bullying situations. If children view their interaction with a victim as having had a positive impact, notably that the victim is seen as being sad at the beginning of the scenario but happy at the end, due to the input from the user, then the children can learn from this experience that helping someone to cope with bullying engenders a positive outcome.

Our approach using ToM methods has been highly insightful, revealing that the use of such methods offers considerable potential for exploring the user experience in technology-enhanced social and emotional learning experiences. The results from our study have contributed to the redesign of FearNot! In FearNot! Version 2.0, children are offered the opportunity to help and advise the victim over several weeks, extending the interaction. Even where the bullying situation is not resolved, a final dialogue still occurs in which the victim thanks the user for his/her advice, ending the interaction with a positive comment. This is intended to increase the likelihood that users feel that they have had a positive impact on the bullying situation for the victim. FearNot! Version 2.0 has recently been evaluated with 800 children in classrooms in the UK and Germany (Sapouna et al., in press).

FearNot! reflects cultural and social norms, expectations and the preferred bullying coping strategies used in Europe. The scenarios and character interactions in the UK and German versions are similar, with the appropriate response to bullying being to tell someone and to reduce the victim's isolation. FearNot! has been developed for European schools and

has a Western bias in terms of what is considered to be an acceptable way of intervening in a bullying situation and how to support the victim. FearNot! is currently being adapted for use in a number of countries, including China, America, Mexico and Poland. Results from these studies will indicate FearNot!'s relevance to different cultures.

We have incorporated ToM methods into a range of instruments in FearNot! Version 2.0. Currently, the interaction logs generated through the use of FearNot! Version 2.0 are being analyzed using a ToM framework based on the work presented in this paper. The analysis focuses on interaction data to understand children's social and emotional interpretations of characters and the possible transfer of positive coping strategies into their school situations. The scale of correctness has been redesigned and now is based on the aggregated results from all children, rather than on an adult perspective, as was presented in this paper. This revised scale enables us to identify if a child's responses are "correct" in relation to their peer group, that is, typical for the age group. This change reflects the considerable differences in ToM between the age group and adults identified in this study.

The identification of children's interpretation of virtual characters in social learning scenarios provides opportunities to redirect potentially inappropriate perceptions to more socially acceptable through effective affective teaching within VLEs. Our current research focuses on analyzing data from the large scale evaluation, seeking to understand the impact that longer term interactions with FearNot! have on a child's ToM and the implications that this has for the design of characters and scenarios aiming to improve children's social interactions.

CONCLUSIONS

Whilst cognitive approaches have been of considerable benefit for understanding and improving HCIs, their applicability to interactions focused on social activities is relatively limited. With the increase in applications intended to support social and recreational activities, there is a clear need to extend HCI by including alternative approaches to understanding users. ToM methods offer an approach that enables an insight into social awareness and emotional understanding of interactions involving social interactions rather than purposeful tasks. Such insights are crucial in ensuring that appropriate interactions, dialogues, and experiences are integrated into social and emotional applications.

In this paper, we have identified that ToM methods offer considerable potential for understanding how children interpret synthetic characters' social and emotional states. Further, our results highlight that adults and children have different perspectives on how victims and bullies are feeling. Understanding the child's view has enabled us to improve FearNot! in Version 2.0, providing children with an emotionally positive experience, that of helping a victim, and increasing their well-being.

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